

BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 4

APRIL 1959

PART 20

INSTITUTE NEWS

Spring Meeting: Cocktail Party

A cocktail party will be held in the Hoare Memorial Hall, Church House, Westminster, after the Annual General Meeting on the morning of Tuesday, 14 April.

Symposium on "The Application of Thin-Film Techniques to the Electron-Microscopic Examination of Metals"

A Symposium on "The Application of Thin-Film Techniques to the Electron-Microscopic Examination of Metals," organized by the Metal Physics Committee, will be held at the Royal Institution, London, on Thursday, 12 November 1959. Seven papers have been invited for the Symposium and will be published in the *Journal* in advance of the meeting.

Report of a Conference on "Atomic Mechanisms of Fracture"

Professor N. J. PETCH, University of Leeds, has accepted an invitation from the Metal Physics Committee to give a report on the proceedings of a conference on "Atomic Mechanisms of Fracture" which is to take place in Swampscott, Mass., on 12-14 April.

Professor Petch will speak at a meeting to be held at the Institute's Headquarters, 17 Belgrave Square, S.W.1, at 6.30 p.m. on Thursday, 28 May 1959.

Election of Officers 1959-60

The following have been elected to fill vacancies on the Council and will take office after the Annual General Meeting on 14 April:

As President

G. L. BAILEY, C.B.E., M.Sc., F.I.M. (Director, The British Non-Ferrous Metals Research Association).

As Vice-Presidents

HUGH FORD, D.Sc., Ph.D., Wh.Sch., M.I.Mech.E. (Professor of Applied Mechanics, Imperial College of Science and Technology, University of London).

E. H. JONES, A.R.I.C., M.I.M.M. (Joint Managing Director, Capper Pass and Son, Ltd., North Ferriby).

H. O'NEILL, M.Met., D.Sc., F.I.M. (Professor of Metallurgy, University College of Swansea, University of Wales).

As Honorary Treasurer

D. P. C. NEAVE, M.A., M.I.Mech.E. (Director, The British-American Metals Co., Ltd.; Capper Pass and Son, Ltd.; James Bridge Copper Works, Ltd.; and Wolverhampton Metal Co., Ltd.).

As Ordinary Members of Council

W. O. ALEXANDER, B.Sc., Ph.D., F.I.M. (Assistant Research Manager, Imperial Chemical Industries, Ltd., Metals Division, Birmingham).

N. P. ALLEN, M.Met., D.Sc., F.I.M., F.R.S. (Superintendent, Metallurgy Division, National Physical Laboratory, Teddington).

F. DICKINSON, B.Sc.(Eng.), F.Inst.P., F.I.M. (Manager, Development and Research Department, The Mond Nickel Co., Ltd., London).

L. ROTHERHAM, M.Sc., F.Inst.P., F.I.M. (Research Member of the Central Electricity Generating Board, London).

Senior Vice-President 1959-60

The Council has elected Sir RONALD PRAIN, O.B.E., to serve as Senior Vice-President for 1959-60 and he will be its nominee for the Presidency in 1960-61.

Engineering, Marine, Welding, and Nuclear Energy Exhibition

Each member should have received with the Spring Meeting programme a ticket for the Engineering, Marine, Welding, and Nuclear Energy Exhibition, to be held at Olympia from 16 to 30 April.

Election of Members

The following 22 Ordinary Members, 2 Junior Members, and 17 Student Members were elected on 14 January 1959:

As Ordinary Members

BALLANTYNE, William Brian, L.I.M., Works Superintendent, Scaw Metals, Ltd., P.O. Box 137, Germiston, Transvaal, South Africa.

CARUETTE, Jean Eugène Georges, Directeur pour la France, Compagnie Royale Asturienne des Mines, 42 avenue Gabriel, Paris (8e), France.

CONANT, Louis Alexander, Senior Research Metallurgist, Metals Research Laboratories, Electro Metallurgical Co., P.O. Box 580, Niagara Falls, N.Y., U.S.A.

CULLUM, Roy Derek, A.R.Ae.S., Technical Editor, *Engineering Materials and Design*, Drury House, Russell Street, London, W.C.2.

INSTITUTE NEWS

- ECCELI, Frank, D.Eng., Process Metallurgist, Noranda Copper and Brass, Ltd., P.O. Box 1238, Place d'Armes, Montreal, P.Q., Canada.
- ESTRUCH-SUBIRANA, Benjamin Joseph, Ph.D., Lic.C.Q., Technical Officer (Metallurgical), Imperial Chemical Industries, Ltd., Engineering Developments Department, Billingham, Co. Durham.
- FLAVELL, Harold, Purchasing Director, Herbert Morris, Ltd., Loughborough, Leics.
- HAMMARLUND, Per Erik, M.S., Dr.techn., Manager, Furnace Department, Allmänna Svenska Elektriska A B (A.S.E.A.), Västerås, Sweden.
- JENKINS, Alfred, B.Sc., Manager, Sintered Metals Department, Ferodo, Ltd., Chapel-en-le-Frith, Stockport.
- MCDOWALL, Ian Pearson, B.Sc., A.I.M., Senior Metallurgist, Pyrotenax, Ltd., Hebburn, Co. Durham.
- MILLS, Raymond, A.I.M., Senior Scientific Officer, General Electric Co., Ltd., Applied Electronics Laboratories, Stanmore, M'sex.
- MUKERJI, Mohi Mohon, B.E.E., Bhilai Steel Project (E.E. Department), Bhilai-1, Drug, M.P., India.
- ORLANDO, Luigi, Dott., Direttore Generale, Società Metallurgica Italiana, Borgo Pinti 99, Florence, Italy.
- ROBINSON, Peter James, B.Met., A.I.M., Technical Officer, Technical Service Section, Research and Development Department, The Associated Ethyl Co., Ltd., Ellesmere Port, Cheshire.
- SEEMANN, Professor H. J., Dr.phil.habil., O. Professor und Direktor, Institut für Metallkunde und Metallphysik, Universität des Saarlandes, Saarbrücken.
- SHERMAN, John W., B.S., St. Joseph Lead Co., Herculaneum, Mo., U.S.A.
- SINHA, Hari Narayan, B.Sc., M.Eng.Sc., Ph.D., A.I.M., Assistant Professor of Metallurgy, Indian Institute of Technology, Dr. Annie Besant Road, Bombay 18, India.
- SMITH, Andrew, A.M.I.Prod.E., Lecturer in Engineering, Department of Mechanical Engineering, Technical College, Bath.
- SMITH, James Francis, B.S., Manager, Anaconda Aluminum Company, Columbia Falls, Montana, U.S.A.
- THÜMMER, Ernst Fritz, Dipl. Chem., Dr.Ing.habil., Bereichsleiter in Zentralinstitut für Kernphysik, Postfach 19, Rossendorf bei Dresden, Deutsche Demokratische Republik.
- WALTHER, William Dean, Sc.D., Technical Director, The Dayton Steel Foundry Co., 1366 Miami Chapel Road, Dayton 1, Ohio, U.S.A.
- WHITEHOUSE, Geoffrey, Works Manager, Hard Metal Tools, Ltd., P.O. Box 27, Wolverhampton.
- DOHERTY, Roger Davidge, Undergraduate, Department of Metallurgy, University of Oxford.
- EMBURY, John David, Undergraduate, Department of Metallurgy, University of Manchester.
- GRINBERG, Adolfo, Lic. Ciencias Exactas, Investigador, Comisión Nacional de Energía Atómica, Buenos Aires, Argentina; (temporary address): Postgraduate School of Physical Metallurgy, University of Sheffield, Arnold Laboratory, Sheffield 1.
- HANKINSON, Roger James, Undergraduate, Department of Metallurgy, University of Cambridge.
- HENDRY, Barrie, Undergraduate, Department of Metallurgy, University of Manchester.
- HERSHMAN, Alan Abraham, Undergraduate, Department of Metallurgy, University of Cambridge.
- MORRIS, Alan William Henry, Undergraduate, Department of Metallurgy, University of Birmingham.
- ORME, John Trevor, Undergraduate, Department of Metallurgy, University of Sheffield.
- POWIS, John Charles, Metallurgical Assistant, British Oxygen Gases, Ltd., Metallurgical Department, Edmonton, London, N.18.
- RICHARDSON, Stephen George Gleadow, B.Sc., A.R.S.M., Assistant Metallurgist, The Telegraph Construction and Maintenance Co., Ltd., Metals Division, Crawley, Sussex.
- ROMER, Hugh Frank, Undergraduate, Department of Metallurgy, University of Cambridge.
- SINGH, Balwant, B.A., Assistant, Metallurgical Research Laboratory, The Fairey Aviation Co., Ltd., Hayes, M'sex.
- SPIRA, Terence Anthony, Research and Development Laboratory, The Fairey Aviation Co., Ltd., Hayes, M'sex.
- YELLAND, Trevor Emerson, Undergraduate, Department of Metallurgy, University of Cambridge.

The following 11 Ordinary Members, 1 Junior Member, and 9 Student Members were elected on 10 February 1959:

As Ordinary Members

- BUFFINGTON, Francis Stephen, Sc.D., Associate Professor of Mechanical Engineering, California Institute of Technology, Pasadena, Calif., U.S.A.
- GHOSE, Aurobindu, Trainee Metallurgist (mail): 9 Commercial Street, Kenfig Hill, Glam.
- HOLM JOHNSEN, Oivind., Plant Manager, A/S Nordisk Aluminiumindustri, Holmestrand, Norway.
- LANGE, Professor Gustav Alfred, Dipl.Ing., O. Professor und Institutsdirektor, Metallhütten-Institut und Probierlaboratorium, Bergakademie Freiberg, Freiberg (Sachsen), Deutsche Demokratische Republik.
- NEWKIRK, John B., B.Met.E., D.Sc., Research Metallurgist, Research Laboratory, General Electric Co., Box 1088, Schenectady, N.Y., U.S.A.
- VON PUTZ, Hans Peter, Assistant to Research Manager, Frederick Smith and Co., Ltd., Trafford Park, Manchester.
- SEIGLE, Leslie Louis, Sc.D., Manager, Metallurgy Laboratory, Sylvania Electric Products, Inc., P.O. Box 59, Bayside, Long Island, N.Y., U.S.A.
- SISTARE, George Henry, Jr., M.S., Chief Research Metallurgist, Handy and Harman, 1770 King's Highway, Fairfield, Conn., U.S.A.
- SPAULDING, Howard Stuart, E.Met., Technical Superintendent, Kaiser Aluminum and Chemical Corp., Box 676, Newark, Ohio, U.S.A.

As Junior Members

- BESWICK, Derek Watts, Assistant Fuel Chemist, Sheldon Iron and Steel, Ltd., Etruria, Stoke-on-Trent, Staffs.
- DAY, Frederick George, B.Sc., A.I.M., Research Metallurgist, Research Division, High Duty Alloys, Ltd., Slough, Bucks.

As Student Members

- BUXTON, Simon Lyon, Undergraduate, Department of Metallurgy, University of Cambridge.
- CLARK, Hector McIntyre, Student of Metallurgy, Manchester College of Science and Technology, Manchester 1.
- DEAN, Robert Joel, Undergraduate, Department of Metallurgy, University of Birmingham.

PERSONAL NOTES

SUAREZ, Arturo Arias, Director, Instituto de Investigaciones y Ensayos de Materiales, Universidad de Chile, Casilla 1420, Santiago de Chile, Chile.

WLEÜGEL, Johan, Technical Director, A/S Norsk Aluminium and A/S Nordisk Aluminiumindustri, Lökkeveisen 9, Oslo, Norway.

As Junior Member

MOGFORD, Ian Lawrence, L.I.M., Assistant Experimental Officer, Atomic Energy Research Establishment, Harwell, Berks.

As Student Members

BEURRIER, Alan John, Undergraduate, Royal School of Mines, London, S.W.7.

BLAIRS, Sidney, Undergraduate, Department of Metallurgy, University of Manchester.

GREEN, Ronald Pattinson, B.Sc., Research Student, Sir John Cass College, Jewry Street, London, E.C.

NICHOLAS, Colin John, Undergraduate, Department of Metallurgy, University College, Swansea.

OSBORNE, Francis John, B.Sc., Downing College, Cambridge.

PEACOCK, David Kenneth, Student Apprentice, D. Napier and Son, Ltd., Acton, London, W.3.

PHILLIPS, Richard James, B.A., Department of Metallurgy, University of Cambridge.

PROFFIT, Raymon, Apprentice in Metallurgy, Stewarts and Lloyds, Ltd., Bilston, Staffs.

RUMBOLD, Michael John, Research Assistant, Glacier Metal Co., Ltd., Alperton, Wembley, M'sex.

MR. G. R. SALTER has been appointed a Research Fellow in Industrial Metallurgy at Birmingham University.

MR. D. P. SMITH has been awarded the Ph.D. degree of London University and has now taken up an appointment in the Research Department of Fry's Metal Foundries, Ltd., London.

MR. D. J. SMART has been awarded the B.Sc. degree of the University of Manchester and has taken up a post with the Virginia (O.F.S.) Gold Mining Company, at Virginia, Orange Free State, South Africa.

THE HON. J. KENNETH WEIR has been elected a Director of The International Nickel Company of Canada, Ltd., and a member of its Advisory Committee.

MR. E. WEISS has relinquished his position as Managing Director of Foundry Services, Ltd., to devote more time to the affairs of the parent company, Foundry Services International, Ltd.

MR. L. WORTLEY is now at the Naval Construction Research Establishment, Dunfermline, Fife.

Deaths

The Editor regrets to announce the deaths of:

DR. MARCEL BALLAY, President and Managing Director of the Centre d'Information du Nickel, Paris, on 2 February, 1959.

MR. HUBERT SANDERSON TASKER, Past-President and Fellow of the Institute, in the Radcliffe Hospital, Oxford, on 9 February.

PERSONAL NOTES

DR. D. V. ATTERTON has succeeded Mr. E. Weiss as Managing Director of Foundry Services, Ltd., Birmingham.

MR. P. J. BALDOCK has left the Bristol Aeroplane Co., Ltd., to take up an appointment at the Atomic Energy Research Establishment, Harwell.

MR. FRASER W. BRUCE, President of Aluminium Company of Canada, Ltd., has been elected to the board of Aluminium, Ltd.

SIR JOHN COCKCROFT has accepted an invitation to become the first Master of Churchill College, Cambridge.

MR. A. D. HOPKINS has been appointed Senior Lecturer in Metallurgy at the College of Technology, Birmingham.

MR. R. PHILLIPS has left the A.E.I. Research Laboratories and is now at Aeon Laboratories, Englefield Green, Surrey.

DR. W. I. PUMPHREY has been elected a representative of the Guild of Graduates on the Court of Governors of the University of Birmingham.

DR. S. F. RADTKE has been appointed Research Director of a joint research programme being initiated by the American Zinc Institute, Inc., and the Lead Industries Association.

DR. W. T. ROBERTS has been appointed a lecturer in the Department of Industrial Metallurgy, University of Birmingham.

MR. A. M. ROSE has left Birmingham University and joined Hawker Siddeley Nuclear Power Co., Ltd., Langley, Bucks.

OBITUARY

John Cartland

John Cartland, who died on 28 September 1958, was a member of a Birmingham family which has contributed much to Midland and National life.

He was educated at Malvern College and Birmingham University, studying metallurgy under Professor Thomas Turner and taking his M.Sc. degree in 1911. Subsequently, he was for a short time metallurgist to James Cartland and Son, Ltd.

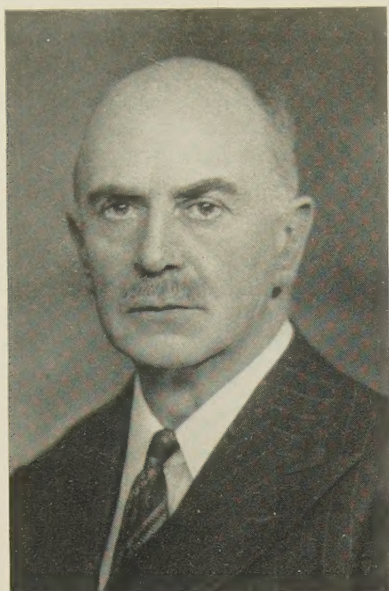
He served through the First World War with distinction; he was severely wounded and was awarded the Military Cross.

After the war he joined Fry's Metal Foundries, Ltd., first as manager of their Manchester foundry, and subsequently became Director and Works Manager in London. He remained with the Company until his retirement in 1952.

Interest in the technical development of the Company's main products, lead and tin alloys, kept him in close touch with the work of the Research Associations and the British Standards Institution. He served on many of their committees and was a Member of Council of the Printing and Allied Trades Research Association. During the Second World War, he was particularly associated with the cause of tin economy; he gave unsparingly of his time and energies to the rather thankless duties of the committees dealing with this.

Throughout his career, John Cartland was one of the Institute's staunchest supporters. He became a member in 1911, missing with some regret the honour of being an Original Member. In the twenties he contributed, with colleagues, several papers dealing with the properties and

applications of lead-tin alloys. He served as Chairman of the London Local Section in 1940-42, as a Member of Council of the Institute in 1943-47, and as Vice-President in 1947-50.



The Institute was one of his major interests, and his wide circle of friends among the members reflected this. His other interests ranged widely: he derived particular pleasure from scientific aspects of matters of everyday experience, which led him into the fields of astronomy, horology, and meteorology. His war wound interfered with, but could not quench, his enthusiasm for climbing and sailing.

Old friends will remember his gift for dry humour, readily sparked off by a paradox or an unusual situation. But above all, they will remember a man of upright character—the old phrase is for him abundantly justified.

R. G. HARPER

LETTERS TO THE EDITOR

Kinetics of Recovery of Cold-Worked Metals from Internal-Friction and Elasticity Measurements

IN connection with the remarks of Dr. Darling¹ on the recovery of cold-worked metals, we should point out that in the letter by Kamel and myself² the value of the activation energy reported was deduced from the annealing temperatures and the reaction times in the range of recovery where sufficient points with the same specific change could be obtained from the recovery curves.

Dr. Darling represented our data graphically and deduced that at higher degrees of recovery the activation energy as obtained from the modulus apparently departs from that calculated from the decrement. He stated that "even within the context of the work described, it may be premature to ascribe a unique, converse relationship to those aspects of the recovery process in cadmium which result in a change of decrement and elastic modulus with time after straining". It should be noted, however, that the activation energies he calculated from our curves are subject, as he says, to large uncertainties arising from the nature of the curves at higher specific changes, and we think that the decrement and modulus

curves of Fig. 2 may be regarded as coincident within the range of probable error.

Concerning the increase of the activation energy with increase of recovery, we have already pointed out in our previous letter that this is probably due to the onset of another relaxation process. We have since (in a paper to be published shortly) investigated this point using samples pre-annealed at 100° C. in order to eliminate the effect of low-temperature recovery. Recovery of modulus and decrement at higher temperatures was found to have an activation energy of about 32 k.cal./mole and is associated with the incubation period before nucleation. It appears as though the low-temperature recovery at temperatures higher than about 120° C. is markedly influenced by the incubation stage.

We have not carried out investigations into the effect of impurities on room-temperature recovery in lightly deformed cadmium. However, preliminary measurements on pure specimens moderately strained by torsion do not appear to show the anomalous increase of decrement with time of rest after deformation.

As recently suggested by Kamel,³ it is likely that the point defects arising from heavy deformation mask the purity sensitivity of internal friction.

EDWARD A. ATTIA

Physics Department,
Cairo University.

THE comments made by Dr. Attia are appreciated and I agree that the difficulties of accurately measuring annealing times make it unwise to ascribe great significance to the differences between the decrement and modulus curves in Fig. 2 in my recent letter.¹ The curves were shown largely to indicate that the data made it impossible to ascribe a definite activation energy to either the decrement or elasticity recovery process, because any value between 20 and 40 k.cal./mole could have been selected.

This general trend towards an increase of activation energy at the higher degree of recovery is very possibly due to the operation of two or more processes in conjunction, but it would appear doubtful on the present basis whether distinct high- and low-temperature recovery processes could be sharply distinguished.

The subject is complicated, and the term "work-softening" applied to it by Dr. Kamel³ is perhaps unfortunate, as the hardness of several cold-worked materials (notably copper, silver, and nickel) can actually increase slightly during this stage of the recovery process.

The suggestion that anomalous increases in internal friction can be explained in terms of dislocation pinning by atmospheres of vacancies is ingenious and may very well be correct. A full description of the mechanism must, however, include an explanation of why it does not operate in materials of commercial purity. There appears to be little doubt that an essential part in these low-temperature recovery processes is played by vacancy migration and that the effect of impurity atoms may be obscured, particularly after considerable deformation has been applied.

A. S. DARLING

Johnson, Matthey and Co., Ltd.,
Wembley, Middlesex.

REFERENCES

1. A. S. Darling, *Bull. Inst. Metals*, 1958, 4, (13), 91.
2. R. Kamel and E. A. Attia, *ibid.*, 1958, 4, (9), 56.
3. R. Kamel, *ibid.*, 1959, 4, (17), 133.

FOUR NEW BOOKS FROM THE AMERICAN SOCIETY FOR METALS

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unknown or of only theoretical interest. It emphasizes that rapid advances in development of vehicles and missiles have made it urgently necessary to learn to cope with these environments.

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INCIDENTALLY . . .

concise, personal instruction on metals is offered by the Metals Engineering Institute, the newest division of the American Society for Metals. Home study courses are available on 17 different metalworking subjects—ranging from Elements of Metallurgy to Metals for Nuclear Power. If you are interested in learning more about metals as they relate to your position in the industry, write directly to:

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DIARY

The Institute

- 7-9 May.** Instructional Meeting for Younger Members on "Design and Operational Aspects of Melting Furnaces in the Non-Ferrous Metals Industry" at Ashorne Hill, Leamington Spa. The meeting will be educational in character and include lectures and discussion groups. Visits will also be paid to two representative works. Registration is necessary and all students must be in residence at Ashorne Hill for the period of the meeting.
- 28 May.** Report on a Conference on "Atomic Mechanisms of Fracture" by Professor N. J. Petch (17 Belgrave Square, London, S.W.1, at 6.30 p.m.).

Powder Metallurgy Joint Group

- 29 April.** Informal Discussion on "Theoretical Aspects of Sintering". Papers will be published in advance in *Powder Metallurgy*. (Church House, Great Smith Street, London, S.W.1, at 9.30 a.m.)

Local Sections and Associated Societies

- 7 May. Leeds Metallurgical Society.** Annual General Meeting, followed by "Electric Melting Furnaces", by F. S. Leigh. (Lecture Room C, Chemistry Wing, The University, Leeds 2, at 7.15 p.m.)
- 7 May. Southampton Metallurgical Society.** Annual General Meeting followed by a Social Function (Small Physics Lecture Theatre, The University, Southampton, at 7.15 p.m.)
- 14 May. London Local Section.** "Electron Probe Micro-Analysis", by T. Mulvey. (Joint Meeting with the Society of Chemical Industry.) (17 Belgrave Square, London, S.W.1, at 6.30 p.m.)

APPOINTMENTS VACANT

METALLURGIST required to take charge of new laboratory in pressure die-casting factory. Responsibilities include the routine metallurgical control of melting and casting of zinc- and aluminium-base alloys and for the planning and supervision of a research and development programme. Some experience of pressure die-casting or other foundry work is desirable, but applications from candidates without such experience will be considered. The post is permanent and pensionable. Apply in writing to the Staff Supervisor, JOSEPH LUCAS (ELECTRICAL) LIMITED, Great King Street, Birmingham, 19, quoting reference PM/D/263.

THE UNIVERSITY OF LIVERPOOL

Applications are invited for the post of Lecturer in the Department of Metallurgy to teach and carry out research in Physical Metallurgy. The initial salary will be within the range £900-£1250 per annum, according to age, qualifications and experience. Applications, stating age, academic qualifications and experience, together with the names of three referees, should be received not later than 18 April, 1959, by the Registrar, from whom further particulars of the conditions of appointment may be obtained.

METALLURGIST

Metallurgist required by expanding organization in the motor car industry.

Duties: General metallurgical control of materials and manufacturing processes; with particular emphasis on the control and investigation into problems concerning deep drawing and pressing of sheet steel.

Qualifications: At least second-class Honours Degree.

Age: Up to 30 years.

Experience in industry: Desirable, but not essential.

Salary: According to experience and qualifications.

Applications may be considered from those graduating this year.

This is a new appointment which offers sound prospects to a qualified person with imagination and who is prepared to join a scientific team.

The successful candidate will report to the Chief Metallurgist, and will work in a highly equipped laboratory.

Applications, which will be treated in strict confidence, should include details of qualifications, experience, personal history and salary to the:—

Personnel Manager,
PRESSED STEEL CO., LTD.,
Stratton St. Margaret, Swindon, Wilts.

MINISTRY OF SUPPLY require Industrial Radiologist at Harefield, Middlesex. Duties involve (a) practical radiography of welds, castings and assemblies, using X-ray sets generating up to 1000 kV; also gamma-ray sources, (b) work directed towards new applications of radiographic inspection, (c) assessment of drawings and radiographic techniques for aircraft and guided-weapon castings and welded parts, (d) assistance in lecturing at training courses. *Qualifications:* Recognized engineering apprenticeship or equivalent training in appropriate trade. Considerable experience essential in radiography of welds and castings, evaluation of radiographic evidence, and development of techniques. Knowledge of welding and foundry practice an advantage. Possession of H.N.C. in Applied Physics desirable and City and Guilds Certificate in Industrial Radiography an added advantage. Salary: £1030-£1250 p.a. Forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A.88/9A. Closing date 17 April, 1959.

ENGLISH ELECTRIC

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Applicants should hold a degree, or its equivalent, and some experience in welding problems is desirable.

Please write giving details of education, qualifications and experience to Dept. C.P.S., Marconi House, 336/7 Strand, W.C.2, quoting reference JM 1814M.